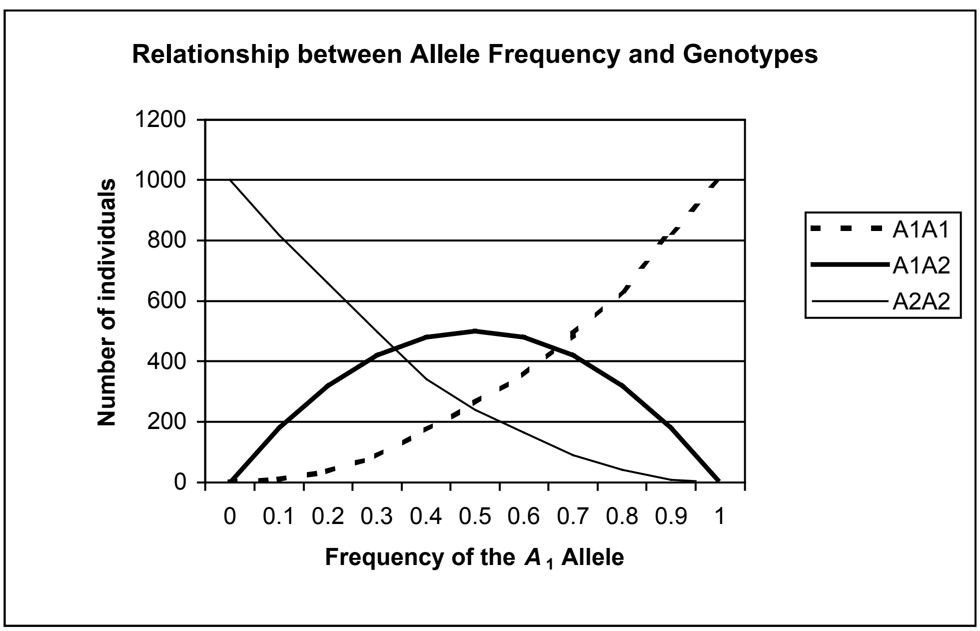
Answers to Exercise 29

Hardy-Weinberg Equilibrium

1. The assumptions of Hardy-Weinberg equilibrium are that there is no gene flow or natural selection in the population. There is no mutation, and the population is large enough so that the effects of genetic drift are negligible. Reproduction is sexual (as opposed to asexual) and individuals mate at random. All individuals are diploid and are capable of contributing both eggs and sperm to the next generation, and thus are *hermaphrodites*. A zygote can be the product of the union of an egg and a sperm from a single parent, and thus individuals can be self-fertilized.

2. When you press the F9 key, new random numbers are generated and a whole new set of observed and expected frequencies are calculated. Note also that your chi-square statistics are automatically updated. On rare occasions, your population may not be in Hardy-Weinberg equilibrium, just by random chance. This is because the genotypes of individuals in the population are generated with a random number that is linked to cell C3. As long as that cell is not equal to 1 or 0, there will be random variations in how the genotypes are assigned to individuals. If we draw a large number of random values, we would expect about half of them to be above 0.5 and half to be below 0.5. Occasionally, by chance, we may not end up with this result. Because the genotypes of individuals are tied to cell C3 and a random number, occasionally the population will be out of Hardy-Weinberg equilibrium.

3. Your graph should look something like this:



For a population of size 1000, the number of heterozygotes will be greatest when the frequency of the A_1 allele (p) is 0.5. When $p = 0$, all individuals in the population are A_2A_2 homozygotes, and when $p = 1$, all individuals in the population are A_1A_1 homozygotes. As the frequency of A_1 changes in the population, the number of individuals of different genotypes change in a nonlinear fashion.

4. The parental population is not in Hardy-Weinberg equilibrium. The allele frequencies for the population are $p = 0.5$ and $q = 0.5$. With these frequencies, the population should consist of 25% A_1A_1 individuals, 50% A_1A_2 individuals, and 50% A_2A_2 individuals. Thus, 500 heterozygotes are expected, but none are present in the parental population. The next generation, however, should be in Hardy-Weinberg equilibrium (although on very rare occasions it will not be in equilibrium, due to random chance). Your results should look something like this: